EFFECT OF POTATO SEED TUBER GLYCOALKALOID CONTENT ON SUBSEQUENT INFECTION BY RHIZOCTONIA SOLANI

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Abstract

Since glycoalkaloids have been shown to have fungitoxic properties, it is important to know what impact this might have on potato plant breeding programs which select for low levels of total glycoalkaloids (TGA) in the tuber. Potato clones with TGA levels ranging between 1.6 and 32.8 mg/100 g fresh tissue were planted in two trials to evaluate the relationship between seed tuber TGA and incidence of Rhizoctonia solani infection in the developing plant. An inoculation procedure was followed in the greenhouse and field to establish uniform infection of potato seedlings. Plants were examined for lesion development on stems and stolons and assigned disease ratings. In the field, yield of malformed tubers was recorded and included in the overall disease ratings. The results reported herein indicate that TGA levels in the seed tuber are unrelated to the severity of R. solani infection in the seedling.

Introduction

In 1933, Willimot (13) summarized the known cases of solanine poisoning in Europe. This illustrated the importance of glycoalkaloids in potatoes used for human consumption. A few years later, Wolf and Duggar (14) determined that a high percentage of the tuber solanine was located in the periderm and could be removed by peeling. Nonetheless, it appears that the solanine in the remainder of the tuber of certain cultivars may be sufficiently high to cause health problems.

Deahl et al. (4) determined tuber glycoalkaloid content was highly correlated with leaf glycoalkaloid content. Wolf and Duggar (14) and Sinden et al. (12) revealed that leaf glycoalkaloid content was related to leaf age. Youngest leaves had highest levels of glycoalkaloids. The highest glycoalkaloid levels found by Wolf and Duggar were in shoot tips of 21-day old Russet Burbank potato plants. Total glycoalkaloid (TGA) levels were found to be highly heritable by Sanford and Sinden (11) and they suggested that potato breeders use breeding stock with low TGA levels. At present, breeders routinely discard new potato clones determined to have high TGA levels.

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While this selection procedure is understandable, the indirect implications are unclear. If glycoalkaloids are responsible in part for disease resistance, low resistance may be inadvertently selected. Many researchers have investigated the relationship between potato glycoalkaloids and disease resistance. Kuc et al. (8) determined that a substance in potato extract was fungitoxic to *Helminthosporium carbonum*. Later studies by Allen and Kuc (1, 2) revealed that the major fungitoxic substances were the glycoalkaloids \( \alpha \)-solanine and \( \alpha \)-chaconine. McKee (9) indicated that potato glycoalkaloids were fungitoxic to zoospores of *Phytophthora infestans*. Measuring radial growth in media, Sinden et al. (12) found solanidine, another potato glycoalkaloid, more inhibitory than \( \alpha \)-solanine and \( \alpha \)-chaconine. Deahl et al. (4) could not relate the tuber or leaf glycoalkaloid content of 15 potato clones with late blight resistance. Resistance to *Alternaria solani*, the causal agent of early blight, was determined to be unrelated to leaf glycoalkaloid content by Goth et al. (7). In an extensive study by Frank et al. (6) no correlation was obtained between TGA content in potato plant parts and resistance to early blight, late blight, common scab caused by *Streptomyces scabies*, or *Verticillium albo-atrum*. Tests have also failed to correlate potato glycoalkaloids with bacterial disease resistance (9, 10).

There have been studies reported which have dealt with cultivar resistance to *R. solani*, but there is no documentation regarding tuber TGA level and infection by this organism. A field and greenhouse study was initiated to evaluate the relationship between seed tuber TGA content and *R. solani* infection of potato plants.

**Materials and Methods**

*Source of Cultivars, TGA Determinations, and Inoculum* — Fifteen potato clones were obtained from the Maine Experiment Station breeding program in March of 1981 and tubers were stored at 3.5°C. Tuber samples of these and other clones were analyzed the same month by the Food Science Department at the University of Maine at Orono for TGA content as a routine evaluation for the breeding project. TGA values ranged from 1.6 to 32.8 mg/100 g fresh tissue according to a 5% acetic acid extraction and titration method developed by Bushway et al. (3). From the 15 available clones, eight were selected for a greenhouse study and five for a field study. The seed for the field test was cut in April. To achieve a uniform seedpiece size with the limited amount of seed available, some of the tubers were used as splits and some were used whole. This resulted in an average seedpiece size of 70 grams.

A culture of *R. solani* was obtained from Dr. Simeon Leach, USDA Soil and Water Laboratory, Orono, Maine, and maintained on potato dextrose agar. Several weeks prior to planting, flasks of sterilized oat grains were inoculated with *R. solani* and incubated at 26°C.